Pastures to Hold and Enrich the Soil

U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN NO. 1900

This bulletin on pastures has special value now that farmers are directing their operations to the all-important business of winning the war. The production goals for milk, beef, wool, and mutton that depend upon our pastures may now prove as important in winning the war as our goals for planes, tanks, ships, and guns.

Agriculture's goals can be reached *through conservation farming that increases crop yields by protecting and building up our soils.* In a long war the maintenance of fertility is especially important, for it is essential that we sustain high production, year after year, for the duration—and longer.

The sod of good pastures protects the soil while it is being used for grazing, makes the soil more productive when it is broken to grow crops in rotation, and reduces the losses of soil by erosion while the land is being tilled.

For the practical guidance of farmers this bulletin outlines how pasture or meadow may best be used on seven classes of land that have differences in soils, slopes, susceptibility to erosion, and the need for protective measures. It points out the value of using pasture in livestock production and emphasizes the importance of pastures in providing essential foods.

Typical examples of conservation planning for farms, involving the use of pastures, are taken from the Corn Belt and the Cotton Belt.

The information contained in this bulletin will serve not only individual farmers but those communities of farms that are banded together in the soil conservation districts to which the Department of Agriculture is furnishing technical help and financial assistance.

Detailed recommendations on seedbed preparation, seed mixtures, and fertilizer application can be obtained from county and community committeemen, county agricultural agents, conservation technicians, or from the State agricultural colleges and experiment stations.

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PASTURES TO HOLD AND ENRICH THE SOIL

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INTRODUCTION

PASTURES afford one of the most effective and economical means of holding and enriching the soil, provided they are managed properly. Two outstanding requirements of proper management in the eastern part of the United States and other humid sections where rainfall is usually adequate for abundant plant growth are (1) a sufficient supply of mineral plant foods such as lime, phosphate, and potash for desirable pasture plants to make enough growth to cover and protect the soil and to provide forage for livestock and (2) regulation of the number and kinds of livestock and the periods of grazing so that the pasture plants can make a vigorous growth each year.

MINIMUM SOIL LOSSES

When vigorous plant growth and regulated grazing are maintained, very little soil is lost from most pasture land. Measured losses are frequently less than 100 pounds per acre annually and average only 700 pounds of soil per acre annually on 13 important types of soil, under typical conditions in the eastern half of the United States, when a dense cover of grass is maintained. This average rate of loss is probably no greater than the rate at which new topsoil is formed. In clean-tilled crops, the same soils lose an average of about 34 tons of soil annually, or 97 times as much as when they are well covered with grass. Under the most favorable conditions, it takes nature from 300 to 1,000 years or more to build an inch of topsoil (fig. 1).

The process of making topsoil is complex; plants play an important part in it. Their living roots penetrate the earthy layers and aid in making the soil mass granular. When the plants die the root holes

serve to admit air and water. The decaying tissues of plants add readily available plant food to the topsoil. Some plants support nitrogen-fixing bacteria on their roots, and other minute forms of plants live on decaying plant tissues, adding more nitrogen to the soil materials. During life, death, and decay, plants contribute to the formation of complete, fertile soils. The millions of plants of grasses and legumes on each acre of good pasture protect the soil and assist very materially in maintaining its fertility.

PASTURE, A SOIL-BUILDING CROP

In United States Department of Agriculture Leaflet No. 165, Soil-Depleting, Soil-Conserving and Soil-Building Crops, A. J. Pieters has

KY–30571

FIGURE 1.—The pasture on the left has had stock on it the year round so that the grass has had little chance to grow. The soil in the pasture on the right is being held by grass and improved by good management. It may be safely cultivated in a long rotation, such as 1 year of corn, 1 year of small grain, and 6 to 8 years of grass. Accordingly, it is class IV land. (See p. 6.) (Photographed August 10, 1938, in Pendleton County, Ky.)

explained the processes of soil building and soil depletion. This leaflet emphasizes the remarkable value of perennial grasses in developing fertile soils such as the black prairies and points out the part played by legumes in conserving and building soil. More on the use of legumes is contained in Leaflet No. 163, Legumes in Soil Conservation Practices, by A. J. Pieters. Mixtures of grasses and legumes may produce two or three times as much hay or pasture as grass alone.

As legumes and perennial grasses are the chief pasture plants and a pasture sod should always contain a mixture of such plants, putting land into properly managed pasture is truly a soil-building practice. In sharp contrast is the use of the soil for row crops, such as corn, cotton, potatoes, or tobacco, as commonly grown on sloping land. Losses of soil under such crops average over 30 tons of soil from each acre annually and in extreme cases may run as high as 150 tons, which

is equal to 1 inch of topsoil, or about one-seventh of the average topsoil, the only fertile soil on most land. Such losses when repeated on the millions of acres that are in corn and other intertilled crops subject to erosion result in enough soil to cover an 80-acre farm 7 inches deep going down the Mississippi River every hour.

PASTURES IN ROTATION INCREASE CROP YIELDS

When sloping land is kept in good pasture the wastage of soil is stopped. In addition, the soil under a pasture sod actually becomes more productive and requires a minimum expenditure for mineral

KANS-1080

FIGURE 2.—Beef cows grazing on second-year sweetclover on class I land (see p. 6) in Franklin County, Kans., in May. As a supplemental or temporary pasture, sweetclover rates very high, often carrying an average of 1½ head of mature cattle per acre from about May 1 to July 31.

plant food. Most of the mineral matter in the forage consumed by the grazing stock is returned directly to the soil if they are kept on pasture continuously. Only a fourth or less of the minerals is retained in the bone and other tissues of the livestock. Furthermore, the decaying grass roots add humus to the soil, and the humus in turn converts the raw minerals of the soil into forms that can be used by plant roots. In addition, the growth of grass roots has a beneficial mechanical effect. Their taking up water from the soil particles causes larger and more stable soil granules to be formed. These granules improve the tilth of the soil. It becomes easier to work and allows water to soak in more rapidly. The water-holding capacity is also improved by the increased granulation and greater content of humus.

Consequently, perennial grass and legume pastures in rotation with cultivated crops result in larger crop yields. In the first place, when

the sod from a good pasture is plowed up, an increased supply of plant food is made available. In the second place, moisture conditions are more favorable. In the third place, most plant diseases and pests are reduced. In the fourth place, soil losses are lessened. Therefore, it is very apparent that putting land in good pasture is like putting money in a bank where it is certain to draw interest while the principal is insured against loss (fig. 2).

GOOD PASTURES REDUCE LIVESTOCK-PRODUCTION COSTS

Grass produces feed at the lowest cost but not the most feed per acre in all cases. By establishing and maintaining mixtures of grasses and legumes on severely eroded soils, pastures may be made to produce more feed per acre than corn and grain crops on such land. In many

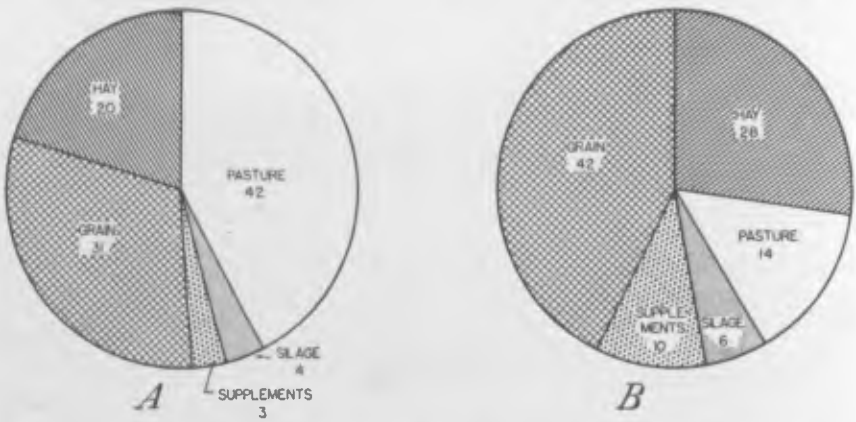

FIGURE 3.—*A*, Pasture supplied 42 percent of the total digestible nutrients consumed annually by livestock on a group of farms in south-central Indiana; *B*, cost of this pasture was only 14 percent of the total annual feed cost. (Courtesy of Purdue University Agricultural Experiment Station. Figures rounded.)

cases this requires an initial expenditure of as much as $10 per acre for lime, fertilizer, and seed. Many experiments and surveys as well as the general experience of farmers prove that grass is the lowest cost feed. There is an old saying, "No matter how cheap corn is, grass is cheaper." Harvested feed usually costs several times as much as pasture. On a group of farms in Indiana (fig. 3) the cost of 1,000 pounds of digestible nutrients in harvested feed was $10.17. On the same farms the digestible nutrients from pasture cost $2.01 per 1,000 pounds.[1]

It is common knowledge that dairy cows usually produce winter milk at a loss and that profits come chiefly as a result of the lower production costs during the grazing season. The successful production of beef calves and fat lambs is dependent on the cheapness and high nutritive value of grass, supplemented by cheap roughages and a small proportion of concentrated feed. Farmers sometimes feel that a small margin of profit on a large volume of products gives them a larger income than a wide margin on a smaller volume of products.

[1] Smith, F. V. the economy of pastures in the limestone area of southern Indiana. Indiana Agr. Expt. Sta. Bul. 454, 1940.

They neglect to count the greater requirements of their own labor in making greater use of harvested feeds and overlook the soil losses by erosion, which occur when they plow, harrow, disk, and cultivate to produce crops and then remove so much of the crop for feed that the ground is left bare after harvest. Erosion may occur on badly managed pastures, but the soil losses are much less than on the same land in cultivation.

A large part of the badly eroded pasture land so prevalent in most parts of the country is the result of soil having been washed away while the land was being cropped. When it became too poor to pay the costs of putting in a crop, it was abandoned by the plowman, and livestock were turned in to eat whatever would grow there. Such land cannot profitably be "let go to pasture," for erosion goes from bad to worse. Rather, it must be "put to pasture" after being built up for that purpose by the use of lime, fertilizer, and seed, as stated above. That takes work and costs money, but it pays on most soils of fair fertility and is a necessary investment if such land is to be used for any other purpose than reforestation.

SELECTING LAND FOR PASTURE

Despite all the advantages of a pasture sod, it is obviously impossible to put all cropland in pasture. About 30 percent of our present crop acreage is used to produce fiber and food crops. The other 70 percent is used to produce feed crops for livestock; hence, it is advisable to determine which land should be retained permanently in pasture, which land should be converted from cropland to pasture, which abandoned cropland should be built up so that it will produce pasture, and the extent to which pastures should be used in rotation with cultivated crops. The solution of these problems involving land use and conservation practices is made easier if the land is classified. One method is to classify the land according to its use capability, which depends on physical properties of the soil and the prevailing climate.

CLASSES OF LAND ACCORDING TO USE CAPABILITY

Soil conservation in its broadest sense implies permanent maintenance of the productive capacity of the land. The achievement of soil conservation not only requires that the land be used for the purpose to which it is best suited, but also necessitates the adoption of such soil-conserving practices as are required for each kind of land. Using land in accordance with its use capabilities requires as a general principle that the crops grown should be adapted to the soil and that the livestock kept should be adapted to the crops that should be grown to meet soil conditions. The land use and soil-conserving measures that are put into practice may be modified or controlled by other factors, such as economic and social conditions, but the foundation plans must be developed in accordance with a physical inventory, particularly of soil conditions, percent of slope, and character and degree of erosion.

Land-capability classes are used to indicate the most intensive tillage that can be practiced safely with permanent maintenance of soil that is suitable for cultivation, and the most intensive use that is consistent with preservation of the soil and its plant cover on land that is *suitable only for grazing or forestry. Of course it is not*

necessary or desirable to use all land to the limit of its use capability. A much larger acreage of sod crops than is necessary to maintain the soil in a condition to resist erosion and maintain yields is often economically desirable on land that is suitable for tillage, on account of the greater cost per acre of producing grain and other crops requiring annual tillage. This practice also builds up a reserve of soil productivity, which is very valuable in emergencies such as the first World War. In England it is a common practice to plow up large acreages of grass in wartimes, but unlike Americans, the English have put the land back to grass soon after war is over.

The classes of land according to use capability described in the following paragraphs and designated by Roman numerals are those in actual use in the Erosion Survey series of the United States Department of Agriculture, which serves to guide farmers of representative agricultural areas in combating soil erosion and maintaining a higher level of soil fertility and crop production.

LAND SUITABLE FOR CULTIVATION

Land suitable for cultivation is divided according to the practices required for its continued safe and permanent use into four use-capability classes, I, II, III, and IV.

Class I land (figs. 2 and 23) can be cultivated safely and permanently without the use of any special practices or treatments. It is of course desirable to use the ordinary good farming practices of the area; that is, to keep up the fertility of the soil by proper tillage and crop rotations and by adding lime and mineral elements such as phosphorus and potassium as needed.

Class II land (fig. 22) requires one or more simple practices such as contour cultivation, strip cropping, and the use of sod crops in the rotation if it is to be cultivated safely. The common practices to keep up fertility are necessary for maximum yields.

Class III land requires intensive practices if it is to be kept in permanent cultivation. The practices required are the same as those for class II, but they need to be very carefully and skillfully selected and applied and there is greater need for sod crops in the crop rotation. Frequently some more complex practice such as terracing is needed.

Class IV land (fig. 1) is suitable for occasional or limited cultivation but is primarily pasture land. Such land may be too steep to terrace, although in some cases diversion terraces may be used advantageously. Since sod crops must be the chief means of protecting the soil, they must be properly managed and renovated often enough to provide profitable grazing by livestock, and at the same time to control erosion. While the grazing management will vary with local conditions, it is very important that such pastures should not be grazed in the spring before the grass is well started, nor should they ever be overstocked. Methods of renovation also vary, they usually consist of breaking up the sod to some extent, sometimes as much as to grow a row crop on the contour, supported by buffer strips of sod, or one or two crops of small grain before reseeding to pasture. In addition, renovation usually includes liming, fertilizing, and reseeding to mixtures of perennial grass and legumes. Some land in class IV may be made very productive and may be kept permanently in a grass type of agriculture.

LAND SUITABLE FOR GRAZING OR WOODLAND USE BUT NOT FOR CULTIVATION

Land unsuited to cultivation, which should be protected against erosion and built up to a higher level of fertility to assure its more effective use for pasture or forestry, is divided into three classes, Classes V, VI, and VII.

Class V land (fig. 4) is suitable for permanent vegetation without special practices. This land is not more than slightly susceptible to deterioration from erosion or other causes. It is suitable for grazing or for forestry, though not necessarily for both. Good management is of course necessary for maximum production.

GA-30218

FIGURE 4.—A well-managed lowland pasture in the latter part of June in Polk County, northern Georgia. This land is poorly drained and is subject to overflow. Hence it is not suitable for cultivation and belongs in class V. Dallis grass and white clover predominate. There is considerable common lespedeza, Bermuda grass, carpet grass, and crabgrass.

Class VI land (fig. 8) is suitable for permanent vegetation but is moderately susceptible to deterioration even under permanent plant cover and therefore requires moderate restrictions in use and possibly special practices. In grazing such land, careful control is necessary to maintain a stand of desirable plants and to keep enough plant material on the surface to protect the soil. Other measures such as the use of fertilizer may be necessary.

Class VII land (fig. 5) is highly susceptible to deterioration and therefore requires severe restrictions in use, and special practices. In pasturing such land, great care must be taken to avoid putting on too many livestock or keeping them there too long. Special practices such as applying fertilizer, cutting brush, terracing, fencing out gullies, and building diversion ditches are necessary.

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GA–30084

FIGURE 5.—This steep, badly gullied land belongs in class VII. It was once a terraced field. As building a pasture would be very slow and expensive, trees are to be planted at the rate of about 1,000 per acre. The scattered stand is far too thin to produce a timber crop of commercial value.

LAND NOT SUITABLE FOR CULTIVATION, PASTURE, OR WOODLAND

All land not suitable for ordinary crop, pasture, or woodland use, although some of it may be productive of wildlife, is placed in one class.

Class VIII land (fig. 6) is not suitable for cultivation or for the production of permanent vegetation that may be harvested under grazing or woodland usage. Desirable wildlife habitat may result from the use of land in any class, but some types of class VIII land are useful primarily for the production of a wildlife crop. Examples are swamps, marshes, mountainous land, sand dunes, and steep cliffs.

THE USE OF PASTURE ON LAND SUITABLE FOR CULTIVATION

Lands that are classed as being suitable for cultivation are usually well adapted to the production of pasture. The levels of fertility necessary to produce moderate to high yields of cultivated crops are sufficient to produce profitable yields of forage for grazing and a vegetative cover for protection against erosion. Too often on farms where all of the land is suitable for cultivation a part is used permanently for pasture, and the rest is used for a rotation of cultivated crops, grain, and hay. In most cases it is much better to use all of the land for crops in rotation, pasturing the hay crops as needed. Such pastures are called rotation pastures. They usually yield more than pastures that are kept permanently on the same land. This is partly because they are on land of somewhat higher productivity. In addition, they produce more because the tall-growing grasses commonly

PA–100209

FIGURE 6.—This muskrat marsh belongs in class VIII. It is not economical to drain such an area. Nevertheless, with a little management, it can be made to produce a very profitable crop of muskrat pelts.

used yield more than grass in permanent pasture and they generally have a larger percentage of legumes. Plowing up pastures regularly and rotating them with cultivated field crops also reduces infestations of animal parasites.

THE USE OF PASTURE ON LAND NOT SUITABLE FOR CULTIVATION

Land not suitable for cultivation should first be divided into grazing land and woodland. Obviously, class V land is well adapted for pasture and is less subject to erosion than classes VI and VII. This is especially true, if land is put in classes VI and VII on account of the sandiness or shallowness of the soil, the extent to which it is eroded, or the readiness with which it erodes (fig. 5). When upland in classes VI and VII is used for pasture in humid regions, it is often necessary to make considerable applications of such materials as lime, phosphate, and potash. On lowland drainage may be a more serious problem than fertility. Trees provide more effective cover on poor soil than grass when the grass must also serve as a source of forage.

WOODLAND GRAZING

Grazing hardwood or broadleaf forests is a poor practice because livestock destroy young trees and may in time destroy the stand. The trampling and grazing of the stock injures the trees, packs the soil, destroys the leafmold or duff on the ground, and increases

run-off and soil losses. If the land is better adapted to tree production than to grass production on account of such factors as low fertility, steepness of slopes, and susceptibility to erosion, the best conditions should be maintained for tree growth; if this is done, so little forage will be produced that its utilization will not compensate for the damage to the tree crop (fig. 7). To be permanently and profitably productive stands of hardwood should be protected from grazing and fire.

In the southern Coastal Plains, where longleaf and slash pine are common, moderate grazing and woodland use may be successfully combined. The old grass on about half of the range can be burned

MD-10075

FIGURE 7.—Conditions for soil protection, run-off control, timber production, and the growth of young trees are ideal in this oak and poplar forest in Anne Arundel County, Md.

off each year by winter burning, when the ground is wet and there is no wind, so that the cattle can get at the young grass before it becomes tough. This system provides old grass for the cattle while the young grass on the burned portion is coming into production and allows cattle to make gains for about 5 to 7 months of the year. It also keeps fire damage to the trees near the minimum which is possible with dual use. Periods of 3 to 5 years' protection from fire may be necessary to get a good stand of seedlings sufficiently well established to withstand such carefully controlled winter burning of the woodland grasses.

An example of what may be expected from grazed woodland is furnished by the experience of two neighbors in Tazewell County, Ill., who, several years ago, fenced off 160 acres of good black, white, and red oak woods that contained a few patches of grass. The 13 yearling steers pastured there from July 1 to the middle of September

gained only 23 pounds per head, or less than 2 pounds per acre. That would scarcely pay the interest on the cost of the cattle, to say nothing of other expenses and the damage to young trees.

ABANDONED CROPLAND THAT SHOULD BE PUT IN PASTURE

Upland not suitable for cultivation can readily be divided into land that has never been broken by the plow or was in cultivation such a short time that little or no damage was done and land that has been cultivated until it is no longer fit for crop production and must be put in pasture or planted to trees if any economic returns are to be obtained (fig. 8).

NC-60186

FIGURE 8.—Such old fields as this Wadesboro soil in North Carolina can be made into a good pasture. Gully treatment, seedbed preparation, fertilizing, and seeding will be necessary. This is class VI land.

The minimum period that the land is in grass will depend upon the class of land and the extent to which erosion-resistant vegetation, such as perennial grass and legume mixtures, is needed to protect the soil from erosion. Because of the cost of legume and grass seeds and the much greater benefit to soil tilth when the land is in grass at least 2 years, crop rotations should be no less than 4 or 5 years in length. It is a common practice to use the first year or two of grass for hay and then graze it with livestock until it is again plowed for grain crops, but there is no hard and fast rule. When cropland in grass is used for hay, the aftermath, or rowen, may be used as a reserve or supplemental pasture in the late summer, fall, or winter. The most important thing is to provide plenty of high-quality forage for the maximum grazing season and hay or silage for barn feeding the rest

of the year. Satisfactory rotations for the four classes of land, when other appropriate conservation measures are used, are as follows:

Class I. 3 years of row crops, 1 year of small grain, and 2 years of legumes or grasses and legumes or continuous row crops where good winter cover crops are grown.

Class II. 1 year of row crops, 1 year of small grain, and 2 years of grasses and legumes.

Class III. 1 year of row crops, 1 year of small grain, and 3 years of grasses and legumes.

Class IV. Not more than 1 year of row crops, 1 year of small grain, and 4 to 6 years of grasses and legumes.

GA-D4-40

FIGURE 9.—Mowing poorly drained bottom-land pasture for weed and brush control after it has been fertilized and seeded.

On most of this cropland, which should be converted to pasture, the primary problem is one of raising the water-holding capacity and the fertility level to a point where desirable grasses and legumes will grow. Much of such land in the North is too poor for bluegrass, and much of it in the South is too poor for Bermuda grass (fig. 5). It requires treatment for a few years to put it in condition to grow good pasture grasses. The most satisfactory procedure is to make soil conditions favorable for such legumes as sweetclover, lespedeza, and kudzu by using appropriate amounts of superphosphate, lime, and other minerals. When sufficient nitrogen and humus have been put into the soil by such legumes, conditions become favorable for pasture grasses that will not only cover the ground and protect it from erosion, but will also produce enough forage to give a satisfactory return from the land. By such soil-building methods, it is not uncommon to double and even triple the forage production of pastures on such land and to do it profitably on most soil types.

Such upland in many places has been cropped until all of the surface soil is washed away. The subsoil that is left will not absorb the rainfall and hold it for plant growth as the surface soil. It is in such poor condition that the expenditures necessary to produce a protective cover of pasture plants simply will not pay quick returns for the necessary investment in fertilizer, seed, and the labor required. While such expenditures may be justified to supply pasture for the family cow and the work stock, there is often enough other poorly drained waste land, not suitable for crops, which may be cleared and would respond more profitably to such an expenditure for fertilizer, seed, and labor (fig. 9). Many areas of infertile or eroded upland can more profitably be used for woodland than for pasture.

POOR PASTURES ON NONCROPLAND

Considerable land has been cleared which either never has been cultivated or was cultivated only long enough to get a stand of grass established. Such land is usually so low in fertility and so steep and erodible that it has been difficult to maintain a sufficiently good sod to protect the soil from erosion (fig. 10). Much of this land on the heavier types of soil can be restored or maintained by applying necessary fertilizers, carefully regulating grazing, and following other good-management practices such as weed and brush control and protection from fire. Disking or plowing may be necessary to establish or renew a stand of desirable plants, provided the land is not too steep, rough,

VA–10364

FIGURE 10.— Clearing the land is not enough to make a pasture. Everyone concerned would have been better off had the trees been left on this class VII land.

LA–30002–C

FIGURE 11.—A 3-acre pasture in East Feliciana Parish, near Clinton, La., March 28, 1938. This 100-percent cover of black medic, white Dutch, hop, and Persian clover, and Bermuda grass was abandoned cropland, class IV, in 1936. In September 1937 the Bermuda grass was carrying an average of 1½ cows per acre.

or rocky. Some of this land is so poor and has so little capacity for holding moisture and plant food that it should be converted to woodland use or even treated as class VIII land with no plans for removing anything by grazing or forestry. The fertilizers and other expenditures that might be applied on such land at a loss had better be used on more fertile soils, where profitable returns are assured (fig. 11).

THE NEED FOR PASTURES—A WELFARE PROBLEM

A recent survey of the 13 principal cotton and tobacco States shows that only 23 percent of the total area is now being used for crops. Of this land now in crops, practically 10 percent should be converted to permanent pasture, meadow, or woodland. Such a change is required not only that the land may be used in accordance with its physical characteristics, soil type, slope, and degree of erosion, but also to help to meet the immediate needs of the people for meat and milk for home use. Farm incomes have been too small to buy such food. According to the census, 27 percent of the farmers in this area have no milk cows, and 37 percent have no hogs. Taking abandoned and nonproductive land suitable for grass or other forage and making it produce for the use of people who have been unable to buy sufficient meat and milk from the surplus products of other sections of the country will improve their health, enable them to produce more, and make them better customers for the goods that others produce.

A PRACTICAL GRAZING PROGRAM FOR THE SOUTHEAST[2]

The uneven distribution of rainfall causes widely varying amounts of feed to be available in pastures during different periods of the grazing season. In periods of high rainfall a permanent pasture may furnish more feed than the animals can consume while, on the other hand, by the end of August the grass may be suffering because of drought. Over a period of less than 1 month the carrying capacity of a pasture may vary more than 50 percent. This condition makes it extremely difficult to maintain an even distribution of grass throughout the growing season where permanent pasture alone is depended on. If pasture acreage is large enough to insure plenty of grass during dry periods there will be an excess during favorable periods, with the result that the pasture will be undergrazed and the quality of the grass will deteriorate. If, on the other hand, the acreage of permanent pasture is reduced to that necessary to provide enough grazing during favorable periods, then pastures will be overgrazed during dry periods, the sod will be injured, and animals will not get enough feed. It is obvious that the animals cannot adjust their feed needs to seasonal conditions; they must have plenty of feed during the entire grazing period if they are to make satisfactory gains. It is not practical to remove animals from permanent pastures during periods of drought unless there is some other place available that will provide feed for them.

In the Southeast a simple grazing program to provide feed throughout the normal grazing period should include (1) permanent pasture on the lowland areas along streams and in natural depressions, (2) sufficient acreage of sericea lespedeza for spring grazing when needed, (3) pure stands of annual lespedeza on suitable upland, and (4) sufficient acreage of kudzu for grazing during the fall months when the grass and annual lespedeza are retarded by drought. On sandy soils where annual lespedeza does not grow well, it will be necessary to increase the acreage of kudzu sufficiently to provide grazing during dry periods in summer. Such an arrangement of grazing plants would insure a supply of feed throughout the grazing period, whereas if permanent pasture alone is depended upon there will be peaks of high production when there is an excess of feed and periods of low production when there will be shortage. Permanent pastures containing white clover and hop clover are usually good in early spring. After these plants pass their peak of growth and mature their seed, however, there is sometimes a shortage of grazing for a period because grass and annual lespedeza, which have been held back by the heavy stand of clover, have not come into full production.

Sericea lespedeza makes rapid growth immediately after killing frosts are over in the spring and will fill the gap between the winter clovers and the summer grasses. In sections where white clover does not grow well it may be necessary to depend upon winter cover crops on cultivated land for late winter and early spring grazing. After the permanent pasture comes into full production, animals can be removed from the sericea so that it may be allowed to produce a crop of hay for winter feed. When seasonal conditions are so favorable that

[2] Prepared by R. Y. Bailey, Chief, Agronomy Division, Region 2, Soil Conservation Service, Spartanburg, S. C.

sericea is not needed for spring grazing, it may be cut for hay when the plants are 12 to 14 inches high. The permanent pasture should supply plenty of feed from about the first of June until about the first of September. By July the annual lespedeza or the kudzu planted on the hilly land will furnish excellent grazing and can be utilized during any short periods of drought during the summer. Kudzu can be grazed at any time during the summer and fall when its use is made necessary by the depleted condition of the permanent pasture and the annual lespedeza (fig 12). A system of this kind will not give year-round grazing but will provide a fairly stable supply of feed from early spring, when clovers in the permanent pasture or when winter cover

ALA-418

FIGURE 12.—Cows grazing kudzu in Tallapoosa County, Ala., on June 22.

crops in cultivated fields are available, until after frosts in the fall. Kudzu can be killed readily by continuous close grazing, but where it is adapted, it supplies excellent temporary grazing when permanent pasture fails in midsummer and fall. It is also an excellent crop in rotation with corn and may make 1 to 2 tons per acre of hay that is practically equal to alfalfa in feeding value.

There are possibilities for winter grazing through the use of small grain, Italian or common ryegrass, and the winter legumes. The early winter growth of such crops usually is limited because of periods of drought which frequently extend from late August to the latter part of November. Naturally when such unfavorable seasons occur, it is impossible to get winter crops started in time to provide grazing before late winter. It is necessary, therefore, for farmers to harvest a suffi-

cient amount of hay and other feed to carry their cattle through the winter. The winter feed can be supplemented to some extent by grazing in the fields during the early part of the winter, particularly where there is a considerable acreage of kudzu on the farm. The frosted leaves of kudzu are grazed by livestock until midwinter.

Bermuda grass and Dallis grass pastures, which are allowed to grow up in the fall, also furnish fair winter pasture. The Bermuda-Dallis grass, common lespedeza, and white Dutch clover pasture shown on the cover page is in Claiborne County, Miss. It carries one animal unit (the equivalent of one mature cow) per acre throughout the year. For about 3 months, supplementary feeding is necessary. It was clipped three times in 1938, and some hay was taken off. This is three-quarter bale cotton land and is some of the best pasture land in the South.

Last but not least in a grazing program is the proper adjustment of livestock to the size of the farm. In too many instances the number of livestock kept on the farm is determined by the desire of the farmer for income from livestock rather than by the capacity of his farm for supporting livestock. It is a serious mistake to purchase livestock for a farm until a plan for forage and feed production has been well developed on the land.

PLANNING A TYPICAL COTTON BELT FARM

In planning rotations of crops and other soil-conserving practices for farms in the Cotton Belt to meet the needs of both the soil and the people, it is relatively easy to provide plenty of nutritious forage for the farm livestock throughout the grazing season. The map of a typical Cotton Belt farm in the Broad River soil conservation district of northern Georgia shows the previous land use (fig. 14) and the use capability (fig. 13) based on the present physical condition of the land Most of the land has been in cultivation, with inadequate soil conservation measures, and the fields are badly eroded. It is evident that there has been too little pasture for the 2 mules, 2 cows, 1 heifer, and 2 hogs that have been kept on this farm. Considerable land has been cultivated that is not suitable for cultivation, and part of the woodland has been grazed.

Figure 15 shows the soil conservation plan for this same farm. Most of the class VI land is being planted to loblolly pine. The remainder of the class VI land is being fertilized and planted to perennial kudzu, Bermuda grass, and Dallis grass. Some class IV land is being cleared of brush, fertilized, and seeded to perennial grass for pasture. All class III land and some class IV land is being kept in cultivation, with over a third of this cultivated land to be planted to kudzu and sericea in contour strips and terrace water-disposal areas. The contour strips of kudzu and sericea will be cultivated in long-time rotations, with the remainder of the cultivated fields, which the map shows as planted in crops (2- and 3-year rotations of cotton, corn, and winter grain with lespedeza). There is also a quarter-acre strip of sericea along the woodland in field 7. It will control erosion on the field border and will supply food and cover for birds and other wildlife.

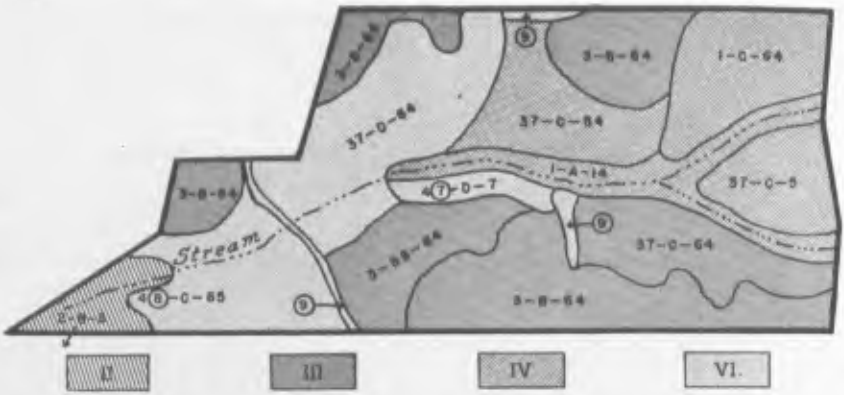

FIGURE 13.—The use-capability map of a 64-acre farm in the Broad River soil conservation district of northern Georgia. The hatchings show the capability classes. This farm has no class I land, which is land suitable for cultivation without special practices. Class II is suitable for cultivation with simple practices, and class III requires intensive or complex practices. Class IV is suitable only for limited forms of cultivation. Class VI is not suitable for any cultivation but may be used for permanent vegetation with moderate care.

Symbols show erosion, slope, and soil type. Erosion symbol 1 indicates slight sheet erosion; 2, moderate sheet erosion; 3, severe sheet erosion; 37, severe sheet erosion and occasional shallow gullies; 3⑦, severe sheet erosion and occasional deep gullies; 4, very severe sheet erosion; 4⑧, very severe sheet erosion and frequent deep gullies; ⑨, large, deep gullies. *A* means slopes of less than 2 percent; *B*, 2–7 percent; *BB*, 7–10 percent; *C*, 10–14 percent; *D*, 14–25 percent; *E*, 25 percent and over. Soil symbol 5 represents Appling sandy loam; 7, Madison gravelly clay loam; 14, Worsham sandy loam; 64 Madison sandy loam; 65, Madison clay loam.

The crop rotations and plantings of trees and perennial forage by fields are as follows: For field 2, containing 3½ acres, there is a 2-year rotation of cotton and small grain with lespedeza on 2 acres in contour strips, and 1½ acres of kudzu for a terrace water-disposal area.

For field 3, on 6 of the 9 acres there is a 3-year rotation of cotton, with crimson clover for winter cover; corn; and small grain affording winter cover with lespedeza. The crops are grown in contour strips one terrace interval in width. The terraces empty into a 1-acre meadow strip, of kudzu. There are also 2 acres of contour strips of kudzu in this field to be rotated in a long-time rotation with the 6 acres in cotton, corn, and small grain.

Field 4, containing 8 acres, has 5 acres in a 2-year rotation of cotton and small grain with lespedeza, and 3 acres in kudzu on the contour.

Field 5 contains 2 acres of kudzu.

Field 6 contains 3 acres of old pasture and 2 acres of new pasture, on which 600 pounds of superphosphate and 1,000 pounds of ground limestone are to be applied per acre. After a good seedbed is prepared the 2 acres of new pasture will be planted with Bermuda grass sprigs, and the whole area will be sown with a mixture of 15 pounds of common lespedeza, 6 pounds of Dallis grass, and 2 pounds of white Dutch clover per acre.

Field 7, containing 10 acres, has 5 acres in a 2-year rotation of cotton and small grain with lespedeza; also 2½ acres of kudzu and ¾ acre of sericea lespedeza for terrace water-disposal areas, 1½ acres of sericea

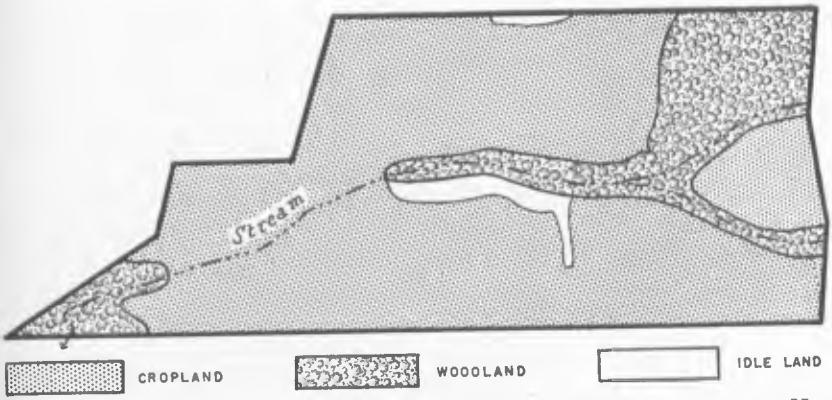

FIGURE 14.—Previous land use for the 64-acre farm shown in figure 13. Note that much steep and badly eroded land (fig. 13) was in cultivation at the time the farm was replanned for conservation of the soil.

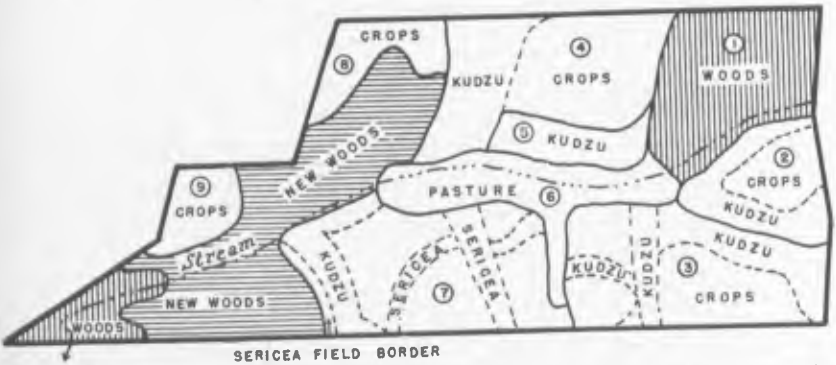

FIGURE 15.—Revised land use on the farm shown in figures 13 and 14, showing cropland, woods, and other perennial vegetation such as pasture, meadow, water-disposal areas, and a field border for wildlife. Note that most of the steep and extremely eroded class VI land has been put in woods and much of the badly eroded class IV land in kudzu and pasture. Some woodland in class IV has been cleared for pasture. Several areas of kudzu and sericea in natural drains adjoining cultivated fields are used for the disposal of water from terraces and other run-off. Field numbers are circled.

in a contour strip, and ¼ acre of sericea in a wildlife border along the woods.

Field 8, containing 3 acres, and field 9, consisting of 2 acres, are in a 2-year rotation of cotton and small grain with lespedeza. Both are terraced, and the crops are grown in alternate contour strips one terrace interval in width.

Fields 1 and 10 are the woodlands. In field 10, 15,000 loblolly pines are to be planted on 12½ acres (10½ acres of new woodland and 2 acres of old woodland).

No increase in livestock is planned for this farm. The main objectives are to hold and improve the soil, to provide more and better feed for the livestock now being kept, to increase the income from livestock and to make a better living for the farm family. A summary of the changes in crop acreages and land use is given in table 1.

TABLE 1.—*Changes in crop acreages and land use on an actual farm in the Broad River soil conservation district in Georgia*

Crop or land use	Before planning	After planning
	Acres	*Acres*
Cotton	15	10½
Corn	9	2
Oats	7	7½
Wheat	3	3
Lespedeza, annual	7	[1] 10½
Crimson clover		[2] 2
Annual hay	3	
Kudzu		12
Sericea lespedeza		2¼
Total cropland	44	37¼
Idle land	6	
Pasture	3	5
Grazed woodland	2	
Ungrazed woodland	9	[3] 21½
Wildlife areas		¼
Total farm area	64	64

[1] This 10½ acres of lespedeza is on the oats and wheat land.
[2] This 2 acres of crimson clover follows the corn.
[3] Of this amount 10½ acres is in new woodland.

PLANNING THE PASTURE CALENDAR FOR THE CORN BELT[3]

Pastures can be provided for a large part of the year in the upper Mississippi Valley by proper planning and management. The length of time pasture can be used varies each year with the length of the growing season (fig. 16). In areas such as southern Illinois and southern and central Missouri, 9 to 10 months of grazing may be expected, while farther north it is not safe to plan for more than 6 or 7 months. Although climatic conditions are humid, white clover cannot be depended on to provide summer pasture after bluegrass stops growing; in some sections, however, it does well in favorable seasons.

Starting the pasture calendar with permanent bluegrass, grazing usually begins in May and should carry nearly one animal unit per acre until the middle of July. If the pasture has been properly renovated and has a good stand of summer legumes it should carry one or more animal units per acre until the middle of September (fig. 17). If there is a shortage of bluegrass pasture, supplementary pasture of spring grain can be used from the middle of June through July. During the remainder of the summer some other pasture, such as alfalfa and grass, Sudan grass, sweetclover, meadow aftermath, or rowen should be provided. Bluegrass can be pastured again in the fall. If spring pasture is needed earlier than the middle of May, winter rye can be used; it may be more profitable, however, to depend on winter feeds, such as hay and silage, for this period. Grass-legume silage from rotation meadow can also be used to supplement summer pasture.

[3] Prepared by Harry H. Gardner, Chief, Agronomy Division, Region 5, Soil Conservation Service, Milwaukee, Wis.

C-6936

FIGURE 16.—The 6-acre pasture on the right was limed, disked, and fertilized with superphosphate and seeded with a mixture of legumes and timothy in the spring of 1936. At the time this photograph was made (June 22, 1937), the 6 acres had been carrying 17 head of cows since May 28.

WIS–539A; WIS–539C

FIGURE 17.—*A*, An overgrazed weedy and badly grub-injured pasture in Grant County, Wis., September 1, 1936. It was renovated with 3 tons of lime, 225 pounds of 20-percent superphosphate, 10 pounds of sweetclover, 5 pounds of alfalfa (not recommended now in a mixture with sweetclover), and 5 pounds of red clover. The cash outlay was $10.32 per acre. *B*, The same pasture 2 years later, August 12, 1938. Clippings on this pasture in 1939 and 1940 showed that the yield was increased by an average of 1,284 pounds of dry forage (44 percent). Prorating the cost of the treatment without the alfalfa seed over a 5-year period, the increased amount of feed on the pasture cost $2.75 per ton. Note that the waterway is fenced out to give the banks maximum protection against erosion.

A PASTURE PLAN FOR AN ACTUAL FARM

The pasture plans for most farms should provide for grazing both the pasture land, or that land not suitable for cultivation, and the cropland at times when grass and legume mixtures appear in the rotation. To illustrate this, plans for a typical farm in the Grant County soil conservation district in southwestern Wisconsin are given.

Figure 18 shows the use capabilities for the various kinds and conditions of soil on the farm. Figure 19 shows the land use on this farm as it was formerly operated. Figure 20 is a map of the farm after it was replanned, which shows present land use. In fields 1 and 2 an 8-year rotation is to be followed that consists of corn, grain with a sweetclover catch crop, corn, grain, and 4 years of alfalfa and timothy to be

FIGURE 18.—The use-capability map of a 176-acre farm in the Grant County soil conservation district in southwestern Wisconsin. Class I is suitable for cultivation without special conservation practices. Class II is suitable for cultivation with simple practices, and class III requires intensive or complex practices. Class IV is not suitable for continuous cultivation.

Symbols show erosion, slope, and soil type. Erosion symbol + indicates deposition of soil; 1, slight sheet erosion; 2, moderate sheet erosion; 3, severe sheet erosion; 27, moderate sheet erosion with occasional shallow gullies; 37, severe sheet erosion with occasional shallow gullies; 4, very severe sheet erosion. A means that the slope is less than 2 percent; B, 2–6 percent; BB, 6–10 percent; C, 10–15 percent; D, 15–30 percent; E, 20 percent and over. Soil symbol 5 represents Wabash silt loam; 10, Ray silt loam; 27, Clinton silt loam; 30, Dubuque silt loam; 33, Dodgeville silt loam.

FIGURE 19.—Land use before a conservation farm plan was made for the 176-acre farm shown in figure 18. The fields had not been balanced for a regular rotation of crops. Considerable class I and class II land had been in permanent pasture.

used for both hay and pasture. The crops are so arranged (table 2) that each year one of the fields can be used as a pasture after the grain crop is harvested. Alfalfa and timothy are always grown on the alternate strips in the fields on which grain is grown (fig. 21).

In the small fields, 4, 5, 6, and 7, a 4-year rotation is to be followed that consists of corn, grain, and 2 years of alfalfa, red clover, and timothy to be used mainly for pasture. Each year a field, which has been in pasture for 2 years, will be plowed up for corn, but contour strips of sod about 25 feet wide and about 8 rods apart will be left unbroken to slow down run-off and catch soil that may be washed off the strips that are in cultivation. At the end of each 4-year period for each field, when the sod is broken for corn, these contour buffer strips will be moved to a new location. This will keep all of the land in the fields in rotation and prevent the formation of bench terraces. The buffer strips also serve as guides for plowing, planting, and cultivating on the contour.

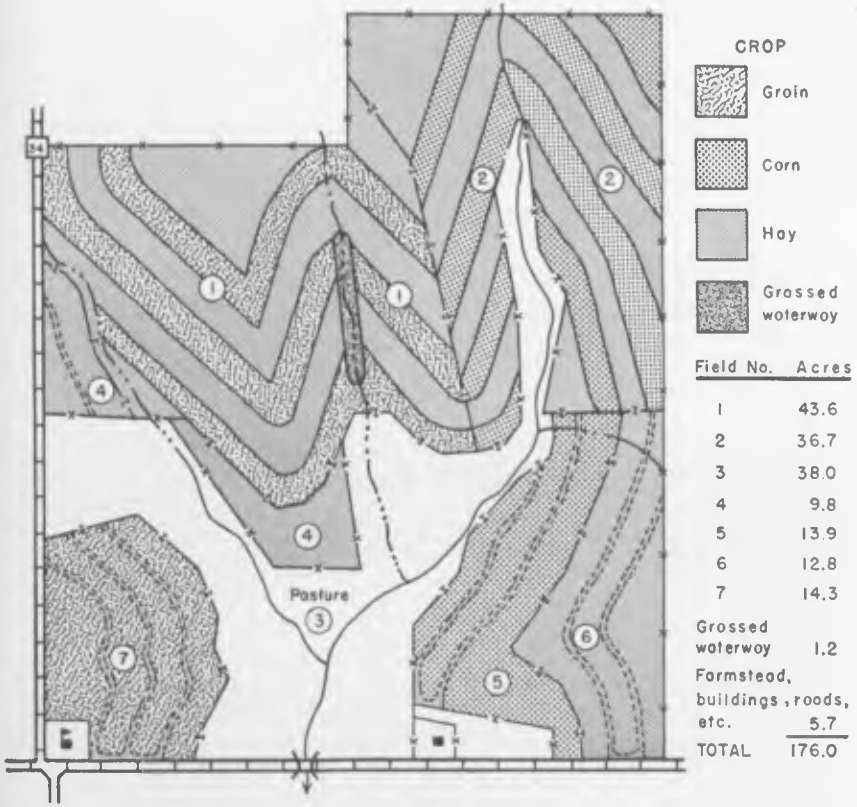

FIGURE 20.—A map of the same farm shown in figures 18 and 19, showing better use of the land, buffer strips of hay, contour and field strip cropping. An 8-year rotation of corn, grain, and sweetclover, corn, grain, and 4 years of alfalfa and timothy is used in fields 1 and 2. A 4-year rotation of corn, grain, and (2 years) of alfalfa, red clover, and timothy is used in fields 4, 5, 6, and 7.

TABLE 2.—*The year-by-year arrangement of strip crops on fields 1 and 2 in the 8-year rotation of corn, grain, corn, grain, hay, hay, hay, hay*

Year	Crop to be grown on the strips shown in figure 20			
	Field 1		Field 2	
	Hay	Grain	Corn	Hay
1941	Alfalfa and timothy	Oats or barley with sweetclover.	Corn	Alfalfa and timothy.
1942	do	Corn	Oats or barley	Do.
1943	do	Oats or barley	Alfalfa and timothy	Corn.
1944	Corn	Alfalfa and timothy	do	Oats or barley with sweetclover.
1945	Oats or barley with sweetclover.	do	do	Corn.
1946	Corn	do	do	Oats or barley.
1947	Oats or barley	do	Corn	Alfalfa and timothy.
1948	Alfalfa and timothy	Corn	Oats or barley with sweetclover.	Do.

As fields 5 and 6 are near the farmstead and are therefore more convenient than fields 4 and 7 for use as hog pastures, the rotation is arranged so that field 5 is in pasture for 2 years, and then field 6 is in pasture for 2 years. This arrangement is shown in table 3. If the field available for hog pasture is divided by a temporary fence so that one-half can be grazed by hogs the first year the field is in grass, and the other half can be grazed the second year, the hogs may be supplied each year with pasture that should be fairly free of parasites.

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FIGURE 21.—Contour strip cropping can be readily adapted to livestock farms by arranging the crop rotation on the fields in such a way that at least one field each year is in alternate strips of a grain and a grass-legume mixture. The first crop of grass may be cut for hay or silage and the growth for the rest of the season pastured along with whatever grows in the grain strips after the grain is harvested. This is class III land. In a 4-year rotation, this field would be in alternate strips of corn and first-year grass the next year.

TABLE 3.—*The year-by-year arrangement of crops on fields 4, 7, 5, and 6 in the 4-year rotation corn, grain, pasture, pasture*

Year	Field 4	Field 7	Field 5	Field 6
1941	Pasture	Oats or barley	Corn	Pasture.
1942	Corn	Pasture	Oats or barley	Do.
1943	Oats or barley	....do	Pasture	Corn.
1944	Pasture	Corn	....do	Oats or barley.
1945	....do	Oats or barley	Corn	Pasture.
1946	Corn	Pasture	Oats or barley	Do.
1947	Oats or barley	....do	Pasture	Corn.
1948	Pasture	Corn	....do	Oats or barley.

The pasture plan for this farm calls for using the permanent bluegrass pasture, field 3, to its capacity from about the middle of May until the middle of July. Then the bluegrass pasture is rested until

about the middle of September. If the bluegrass pasture of 38 acres does not provide sufficient forage for the stock during the spring and early summer, grazing may also be obtained from either one or two of the small fields, 4, 5, 6, and 7, when they are in pasture. If these small fields are not needed for pasture during the early part of the season, they may be cut for hay or silage to be used later in the summer or for winter feeding. Such harvesting for later summer feeding may be profitable in the case of dairy cattle, but is not recommended for beef cattle.

Each year either field 1 or field 2 is in alternate strips of grain and hay, while the other is in alternate strips of hay and corn. When the small grain has been harvested and the hay has been made in the same field, the field can be used for pasture beginning usually about the first of August. As the cattle should be removed from the bluegrass pasture about the middle of July, they can be carried on one or two of the small fields (4, 5, 6, and 7) that are in pasture until the grain and hay field is ready for grazing. Field 1 or 2, together with whatever may be left in the small-field pastures, should carry the cattle until about the middle of September. Then it is very important that the cattle be removed from the rotation pastures and shifted back to the permanent bluegrass pasture, which has had about 2 months of rest. Removing the cattle from the rotation pastures about September 15 and keeping them off until about October 15, gives the alfalfa a chance to build up the supply of plant food in its roots. This rest period of at least a month before freezing weather is necessary to keep the alfalfa plants vigorous and productive. After the middle of Octo-

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FIGURE 22.—This rotation clover pasture in Henry County, Ind., is supplying 8 sows and pigs with palatable, nutritious, and grain-saving forage in April. This pasture is class-II land in the foreground. There is class-I land in the valley and class–III land on the slopes in the right background.

ber the cattle may be returned to the rotation pastures for whatever feed is available and can be safely removed without exposing the soil to erosion. Where a good sod exists and there is sufficient forage, grazing may be continued until snow covers the grass.

By following such a plan for the use of the permanent pasture and the rotation pastures on this farm, there should be plenty of grazing most of each season for 4 horses, 25 cows, 10 sows, and corresponding numbers of young stock (fig. 22). The number of stock to be kept and the periods they are grazed should be adjusted in accordance with the availability of forage and the amount that must be left ungrazed in order to maintain the stand and protect the soil. Rotation pastures also help to avoid losses from worms because they can be arranged to supply clean ground for each pig crop.

YEARLONG GRAZING IN THE SOUTHERN CORN BELT

In the southern part of the upper Mississippi Valley the principle of the pasture-management planning is the same, but the crops used and the time of pasturing are somewhat different. For example, bluegrass can be grazed earlier in the spring. Korean lespedeza is an excellent supplementary pasture for summer, and by using winter grains—winter barley for early fall grazing and winter wheat or rye for early spring grazing—10 months or more of pasture can be provided (fig. 23).

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FIGURE 23.—Korean lespedeza in a wheat stubblefield supplies excellent grazing in July, August, and September. Jackson County, Mo., September 16, 1932. (Photographed by W. A. Stenhouse, Bureau of Animal Industry.)

SPECIFIC INFORMATION ON MAKING AND KEEPING GOOD PASTURES

Soil and climatic conditions vary so much that the kinds and amounts of fertilizer, lime, and seed that should be used and the grazing management practices that should be followed vary greatly not only from State to State (in many cases) but also from county to county and even from one part of a field to another on the same farm. Accordingly, all general recommendations for fertilizing and seeding should be considered as a guide to help in the selection of recommenda-

tions that apply to the particular conditions under which one must work. For example, soils should be tested to determine lime requirements. One part of a 20-acre field may need only 1 ton per acre and the rest of it 3 tons per acre. Plants such as alsike clover and reed canary grass that are best adapted to the wet areas along streams differ from plants such as alfalfa and orchard grass, which are best adapted to well-drained sites. Most of the State agricultural experiment stations and extension services have bulletins, circulars, and mimeographed pamphlets giving information on pasture establishment and maintenance.

The recommendations in these publications are adapted to the particular soil and climatic conditions in the States for which they are written. Accordingly, anyone wanting specific information on the treatment of a particular piece of land for pasture should see his local county agricultural agent or farm adviser or should write to his State agricultural college or experiment station. A few bulletins of the Department of Agriculture giving more general information on pastures are listed below.

SELECTED MATERIAL ON PASTURES

ABSTRACTS OF PASTURE LITERATURE. Soil Conservation Service, SCS–TP–15. 1937. [Mimeographed.]

CULTIVATED GRASSES OF SECONDARY IMPORTANCE. Farmers' Bul. 1433. 1925. (Revised 1934.)

EFFECT OF METHOD AND RATE OF GRAZING ON BEEF PRODUCTION AND PLANT POPULATION OF PASTURES AT BELTSVILLE, MD. Tech. Bul. 538. 1937.

EFFECTS OF FIRE AND CATTLE GRAZING ON LONGLEAF PINE LANDS AS STUDIED AT MCNEILL, MISSISSIPPI. Tech. Bul. 683. 1939.

GRASSES AND LEGUMES FOR PERMANENT PASTURES. Bur Plant Industry, Div. of Forage Crops and Dis. 1934. [Mimeographed.]

THE HOHENHEIM SYSTEM IN THE MANAGEMENT OF PERMANENT PASTURES FOR DAIRY CATTLE. Tech. Bul. 660. 1938.

IMPORTANT CULTIVATED GRASSES. Farmers' Bul. 1254. 1922. (Rev. 1931, 1934.)

PASTURE AND RANGE IN LIVESTOCK FEEDING. U. S. Dept. of Agriculture Yearbook 1939. 1940.

A PASTURE HANDBOOK. Misc. Pub. 194. 1934. (Rev. 1937, 1940).

PASTURE PLANTS AND PASTURE MIXTURES ADAPTED TO DIFFERENT PARTS OF THE UNITED STATES. Bur. Plant Industry, Div. of Forage Crops and Dis. 1933. [Mimeographed.]

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